Appendix C

Engineering Report (Grading Permit Application)

$550 Filing Fee to be Attached

APPLICATION FOR EXCAVATING, GRADING, OR FILLING PERMIT

County of Marin
Department of Public Works
P.O. Box 4186
Room 304, Civic Center
San Rafael CA 94903-4186

August 20, 2002

415/499-3799

Re: Manure Pond Expansion
Barn Pad Expansion
Tim Kehoe, **Kehoe Dairy**
6150 Pierce Point Road
Inverness CA 94937

APN 109-040-001
415/669-1696

The undersigned hereby applies for approval to excavate, grade, or fill on land in unincorporated areas of the County of Marin by performing the following work: (Applicant will describe here fully what he wishes to do using reverse side or extra sheets, if necessary, and attach two copies of plans.)

Applicant's Attention is Directed to Section 23.08 of the Marin County Code

The work proposed involves construction of a milk cow barn pad (3800 cy) and a remote manure storage pond (13800 cy) and associated grading per the attached cover letter, design computations, and construction drawings.

Applicant agrees to do work in accordance with Marin County Code Section 23.08 and the rules and regulations of the Marin County Department of Public Works subject to its inspection and approval.

Marin County Area:_____

Excavation Permit Number:_____

Parcel No._____ Prepared by:_____
Plotted by: _____

Inspection fee, $:_____

Surety bond, $:_____

Permit Issue Date: _____

_____
Owner/Applicant Signature

Tim Kehoe
Kehoe Ranch
6150 Pierce Point Road
Inverness CA 94937
415/669-1696

Form EX04 3/78

Erickson Engineering Inc.
Valley Ford CA 94972-0446 707/795-2498 Voice/Fax

County of Marin
Department of Public Works
P.O. Box 4186 Room 304, Civic Center
San Rafael CA 94903-4186

August 20, 2002

415/499-3799

Attn: Grading and Drainage Review

Re: 13,800 cy embankment for 11 ac ft manure pond levee
3,400 cy pad for stall barn expansion
APN 109-040-001
415-663-1696

Tim Kehoe
Kehoe Dairy
6150 Pierce Point Road
Inverness CA 95437

Enclosed please find design and documentation material for the above referenced projects that are believed to conform to County standards. The work consists of earthwork cut and fill operations to construct: a) an earthfill embankment 0 – 20' high for an 11acre-foot capacity manure storage pond and b) level pads on either side of an existing dairy stall barn to allow enlargement of the structure. The work is located in Point Reyes National Seashore on a large rural parcel in the unincorporated area of Marin County. A summary of design criteria follows.

Grading Summary: The work sites will be cleared of grass and sod. Topsoil will be salvaged and stockpiled for placement over finished grade cut and fill surfaces. Compacted fill earthwork quantities are estimated at 3400 cy for the barn pads and 13,800 cy for the manure pond levee. Cut and fill volumes have been balanced on a project basis to avoid import or export of bulk materials. Certain infrastructure will be relocated or removed to accommodate the grading work, including but not limited to corral fences, existing concrete pads, feeders, fuel storage, an old barn, and a lean-to shed attached to the farm shop.

Resource Agency Reviews: The project sites are in upland off-channel areas. The barn pad expansion site is presently denuded dairy corrals for cows and calves. The manure pond site is a ridge crest pasture with introduced grasses, thistles, and other noxious weeds present. There are believed no habitat, channel, stream, riparian, fisheries, endangered species, wetlands, or other issues or conditions of concern to CDFG or other Resource Agencies at the separate locations. Existing infrastructure between barn and manure pond site consists of ranch roads with gully crossing, fences, and a surface-laid liquid transfer pipe line, none of which will be changed or affected by the site improvements.

Geologic Setting: The California Division of Mines and Geology map archives were consulted to evaluate the site geologic setting. The sites are characterized as being underlain by Pwg Pliocene-era (2 - 5 million years old) Wilson Grove formation (marine sandstone, conglomerate, tuff) bedrock.

The barn construction site is on the east flank of a gentle hilltop ridge crest at 0 – 15% slope, adjoining an area previously leveled for the existing barns. The manure pond site is on a ridge crest at 5 – 15% slope immediately downslope of an existing manure pond. Site topography, soil morphology, and existing cut and fill slopes at both sites is consistent with parent materials of siltstone - mudstone - sandstone and shale subjected to weathering and decomposition. There is no surficial evidence of seepage, soil creep, or landslide-type instability in the construction envelopes.

The geologic map resources do not indicate presence of any ancient fault lines at the contact of the various mapped soils units in the general vicinity. The geologically active San Andreas fault line is located in Tomales Bay, about 2 miles east of the site. The barn pad and manure pond sites could therefore be expected to undergo ground shaking during the lifetime of the project.

Possible earthquake effects include fault rupture, ground shaking, liquefaction, and lateral spreading or lurching. Since there are no known fault lines in the immediate work areas, fault rupture is unlikely. Liquefaction is most closely related to loose or saturated cohesionless soils undergoing ground shaking, and is considered of low probability at the sites due to the presence of moderately cohesive well-drained soils over relatively shallow decomposed bedrock with limited moisture present. The fill materials will be compacted to 90% ASTM D1557, and minor surface runoff will be routed around the sites, minimizing risk of presence of saturated or loose materials. Lateral spreading is related to movement of horizontal alluvial layers adjacent to an exposed face. Lurching is cracking or separation of soil parallel to unsupported cliff or stream banks. Since neither condition is present on site, potential of these conditions occurring is low.

Consistent with site grading activities for a remote agricultural facility, conservative design and construction criteria have been specified in lieu of detailed geotechnical analysis or characterization of site soils. By observation, the sandy loam topsoil and loam subsoils underlain at depth by durable fine-grained siltstone/sandstone are believed to be of moderate to low permeability, suitable for use as pad and embankment fill material. The existing manure storage pond has embankments up to 10' high with no observable seepage in or through the levee structure, providing anecdotal evidence of satisfactory low permeability for embankment construction. Soil plasticity is believed low, based on modest clay content and low level of shrinkage cracking in desiccated soils. Site cut and fill slopes have been specified at an industry standard of 2.0H:1V or flatter, considered conservative under all loading conditions. Specifications are in conformance with standard UBC requirements and minimize site footprint and earthwork requirements at these hillside locations. Topsoil salvage and removal of deleterious organic material is required. 90 percent relative compaction is specified for level lifts at optimum moisture content plus 3% on prepared subgrade to ensure fill integrity and to minimize permeability.

Soils: The USDA-NRCS Marin County Soil Survey Sheet 2 – (Tomales quadrangle) indicates the mapped soils units are #136 (Kehoe loam 9 - 15% slopes) on the uplands containing the work sites. The adjoining lowland areas outside the work area are located in a narrow valley between the work areas where the soils are categorized as #160 (Rodeo clay loam 2 – 5%).

136 – Kehoe Loam 9 - 15%: Per the soil survey, this deep, moderately well drained soil is on rolling uplands and was formed in material derived from sandstone. Slopes are smooth. A typical surface layer includes 36" of dark grayish brown loam classified ML. It is typically underlain by 12" pale to very pale brown fine sandy loam classified ML. Subsoils transition to weathered and decomposed sandstone encountered at about 4'. Bedrock occurs at greater depths and less weathering is observed at depth. Observation of local topography and the adjoining silage pit cut and fill slopes and existing manure pond cut and fill slopes is consistent with the USDA mapped soil units.

Permeability is expected to be moderate, with moderate water holding capacity. Plasticity is low to moderate with surface soil PI at non-plastic to10 and subsoil similarly classified. Corresponding liquid limit ranges are reported at 25 – 35. Runoff on unprotected slopes is expected to be rapid with moderate to high water erosion potential.

Barn Pad Hydrology: Rational Method procedures were used to estimate a 100-year design flow for surface runoff from the barn pad project site. The methodology of CalTrans District 4 was used, per the typical Marin County design approach.

Upslope tributary areas affecting the barn pad work site are relatively small due to constraining topography and the ridge crest location. Vegetated vee ditches and roof runoff controls will be used to the extent possible to divert clean runoff from the manure management system. The westerly pad is cut into native material and will essentially be covered by the barn roof extension. The easterly pad fill will be partially covered by the calf pen roof system. The remaining fill pad will be outsloped at 1% to promote diffuse sheet flow drainage away from structural improvements.

Rainfall values for the 100-year storm in various parts of the work area range from 1.8 to 4.8 inches, per the attached spreadsheet summary. Surface runoff from the uplands and from the vegetated cut slope will be by low-slope vegetated vee ditches per the attached spreadsheet Manning's Equation computations. A 6" – 8" vegetated vee ditch is satisfactory for all flow conditions per the attachments. Roof runoff will be managed using downspouts and directing flow to a 12" n=.012 culvert extension of the existing fresh water drainage system. The calf pen site runoff will be via diffuse sheet flow to downslope areas with permanent vegetation.

Manure Storage Pond Hydrology: Discharge of manured water from waste storage areas is not allowed, per State Water Quality Control Board regulation. System storage volume design criteria is therefore a function of regulatory requirements, annual rainfall totals, storm surcharge volumes, and manure produced within the system, rather than the traditional surface runoff hydrology associated with reservoir design. The manure storage pond is sized to retain the annual design volume without discharge. The pond therefore does not include a principal or emergency spillway and capacity is managed in a manner to prevent overtopping or discharge under all circumstances.

Capacity management includes creation of a storage volume consistent with regulatory requirements, minimizing clean water inputs into the management system, emptying all storage ponds via land application of liquids and solids at agronomic rates over wide areas prior to onset of winter rains, discharge of clean water from empty and clean storage areas until time of use in the rainfall season, and backup/contingency plans and hardware for land disposal of liquid and solid wastes on an as-needed basis throughout the year.

Required system storage capacity has been evaluated for foreseeable agricultural demands and factored into the present design. It includes containment of animal manure and manured surface runoff water for a 600+ cow facility based on site-specific information. Per State Water Code, it is designed to retain runoff for the 10-year wet winter and for the 25-year, 24-hour storm for the entire facility. Design values at this site include 24" average annual rainfall, 35.8" 10-year wet winter rainfall, and 3.6" rainfall for the 25-year 24-hour storm. Computations were completed using a spreadsheet format, which is attached.

The proposed waste storage pond has a water surface of about 1.33 acres at the design storage elevation, with an 11 acre-foot capacity. The structure is the last cell in a series of ponds with about 19 acre-feet total capacity, and therefore will remain unused for about half the rainfall season. During that time, clean rainwater will be discharged, increasing effective system capacity by about 1.3 ac x 1' = 1.3 acre feet relative to actual capacity. The 4+ acre foot pond immediately upstream will settle out any manure solids not already captured in the first 2+ acre-foot cell, so that the material stored in the last pond will be primarily liquid. Liquid can be disposed of by irrigation via an existing system, or by use of an on-site 4200 gallon tank truck for delivery to remote silage fields.

Erosion Controls: The plans and specifications require construction during the dry season, temporary geotextile fencing, seeding and mulching, and other appropriate measures used on an as-needed basis to prevent soil mobilization and sediment transport to downslope areas. Little erosion potential is expected in this moderate rainfall area with work completed during the dry season. Permanent erosion

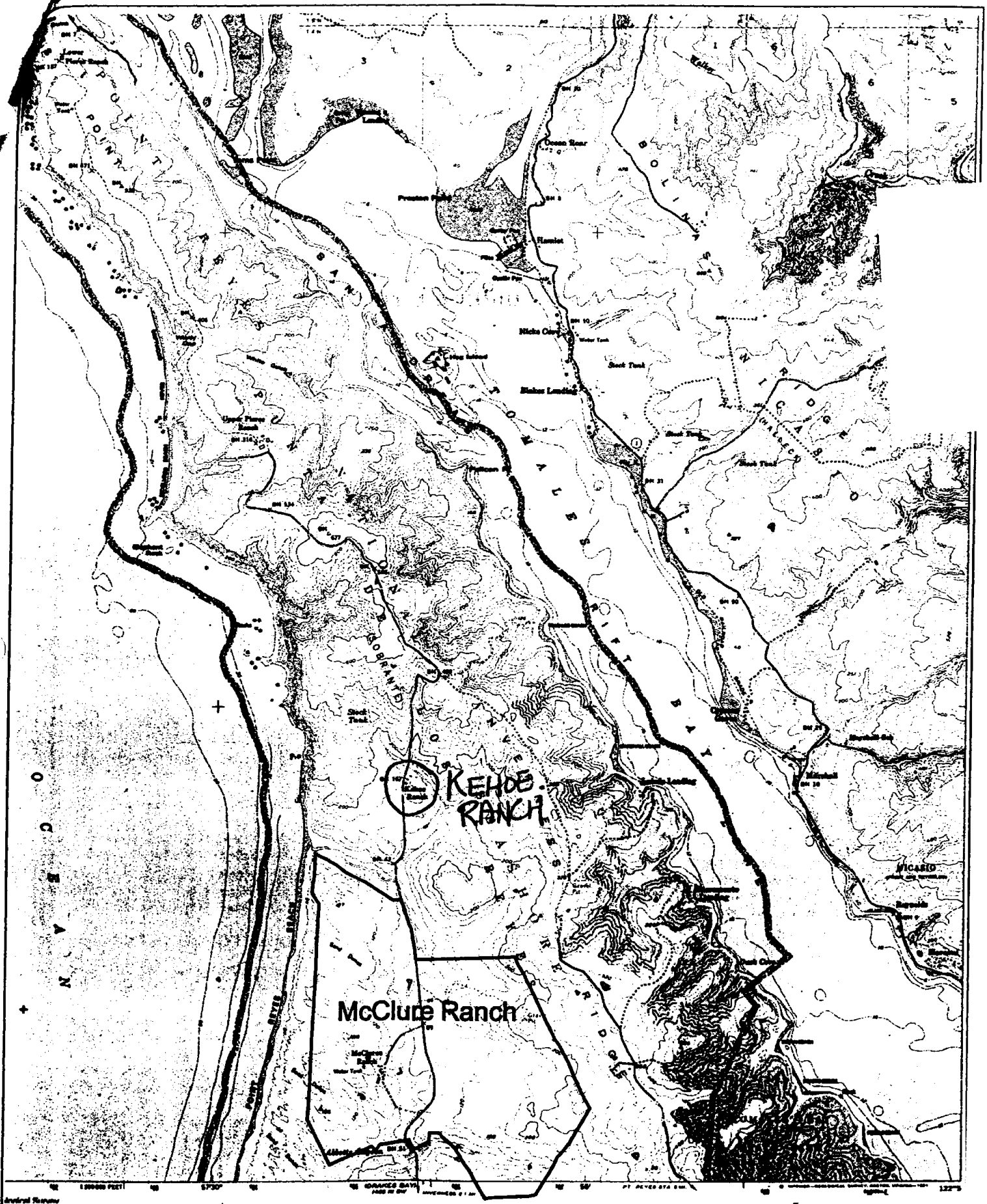
control measures include permanent cover crop conditions on embankments and within the developed hillside areas.

We trust that the narrative above and the enclosed design and construction materials provide satisfactory documentation of the work. Please call if you have comments or questions, or if additional materials are required.

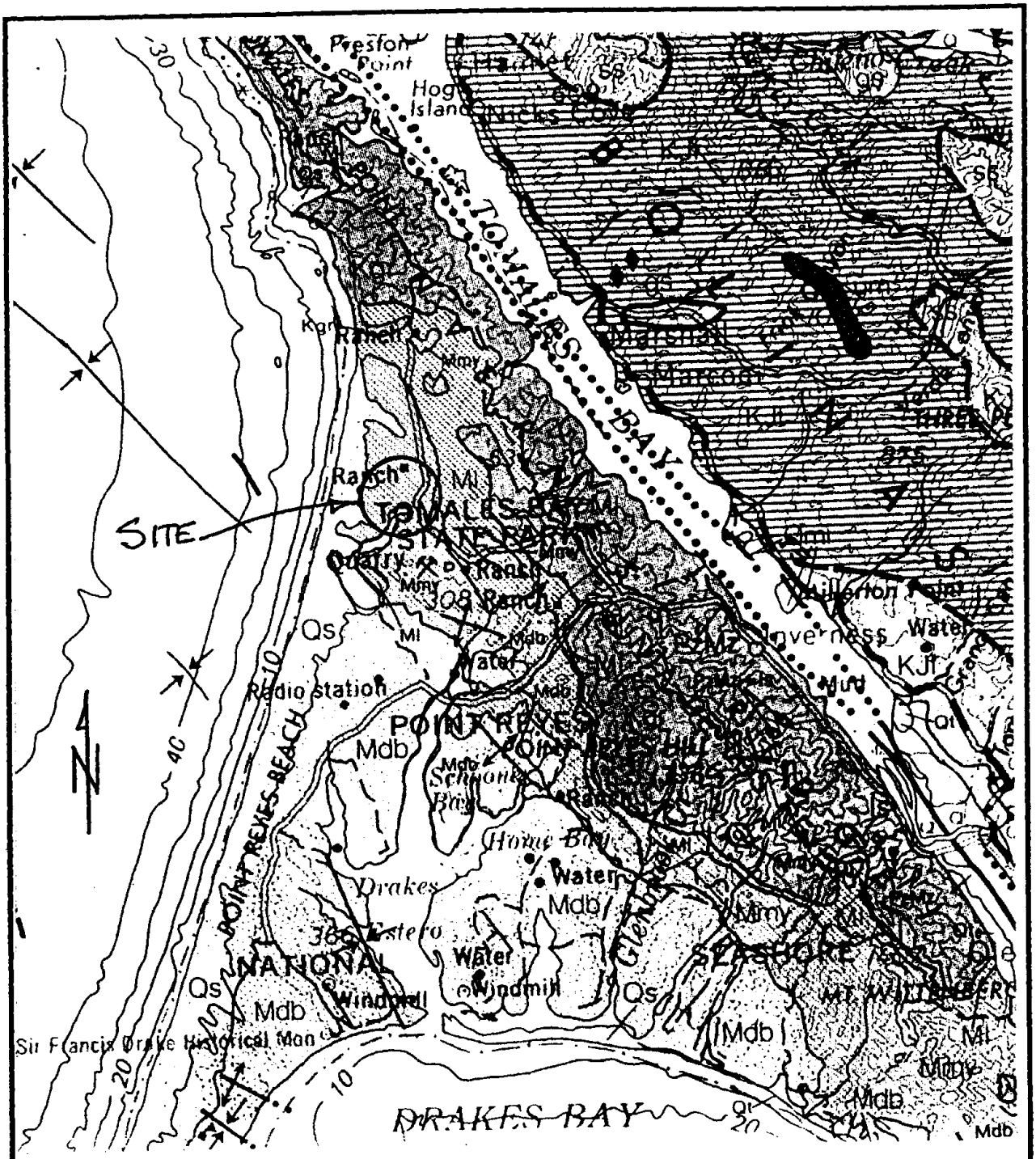
Very truly yours,

Lee Erickson, PhD CE45660 AE468
Civil and Agricultural Engineer

Enclosures: Plans, Engineering calculations
cc: Client
Whitmire Consulting



	DATE: January, 2001 SCALE: 1"= 4000' CHECKED BY: MN DRAFTED BY: EA	Point Reyes National Seashore Project Location Map on USGS Topo "Tomales"	Figure

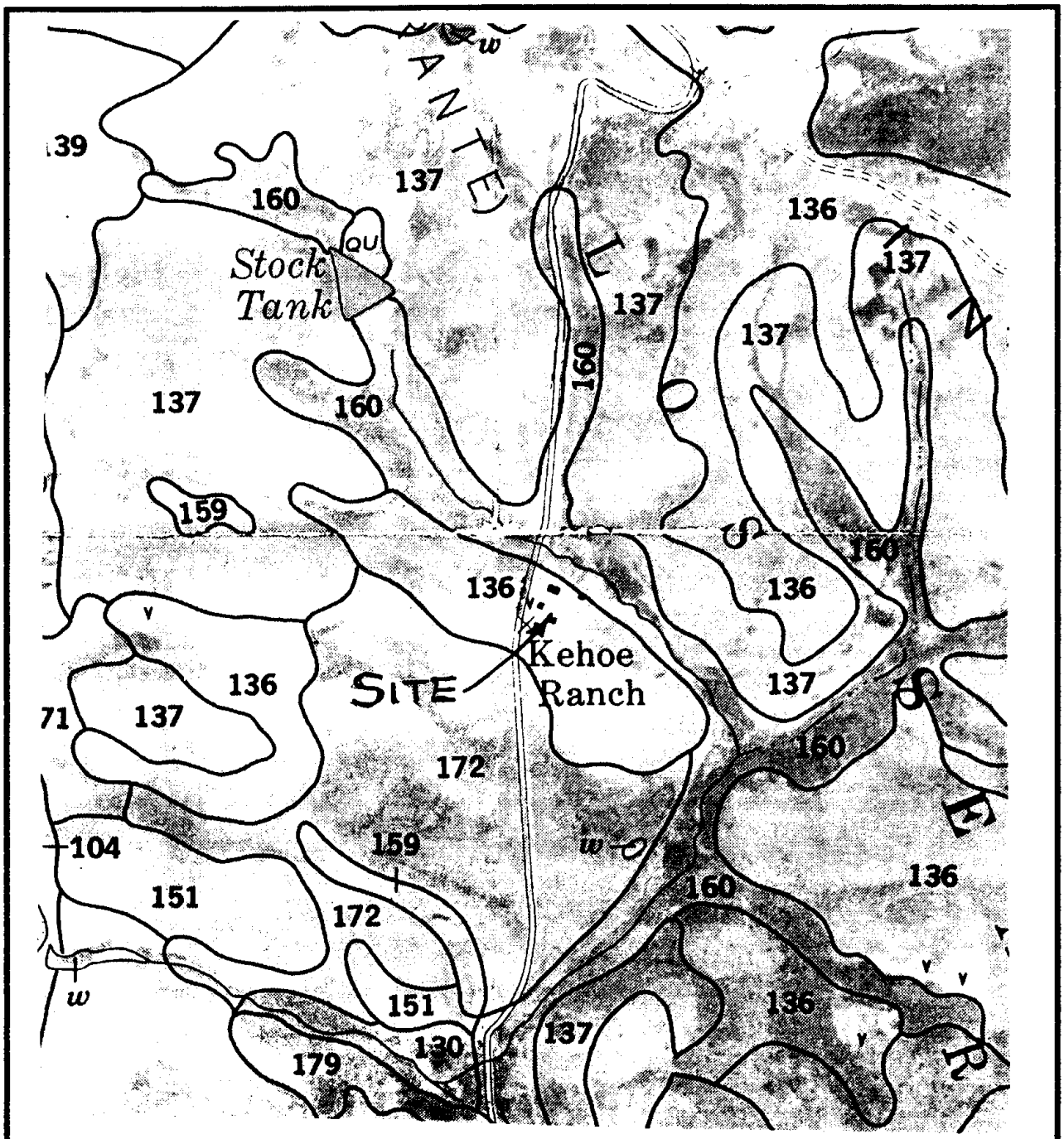


Ranch Barn Pad

- Geologic Setting

Erickson Engineering Inc.
Valley Ford CA 94972-0446
707/795-2498 Voice/Fax

Scale: 1:125,000 May 12, 2001
California Div. Mines, Geology
Santa Rosa Quad Map 2A - Geology

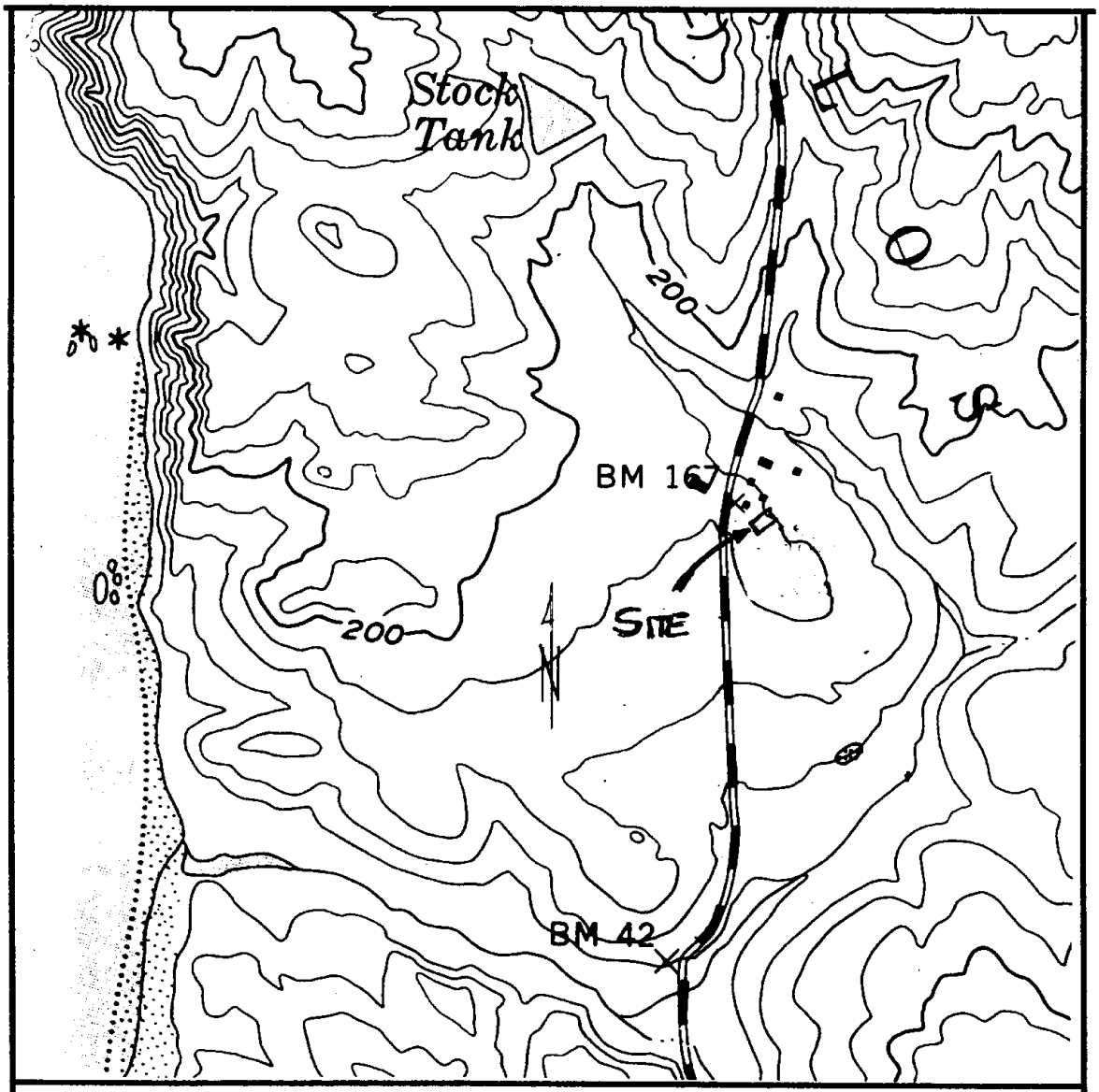


136: Uplands - Kehoe loam 9 – 15%
160: Lowlands – Rodeo clay loam 2 – 15%

Kehoe Dairy, Pierce Point Road, Inverness CA 95437
Soils per USDA SCS Marin County Soil Survey

Erickson Engineering Inc.
Valley Ford CA 94972-0446
707/795-2498 Voice/Fax

June 4, 2002
Map Sheet Tomales Point



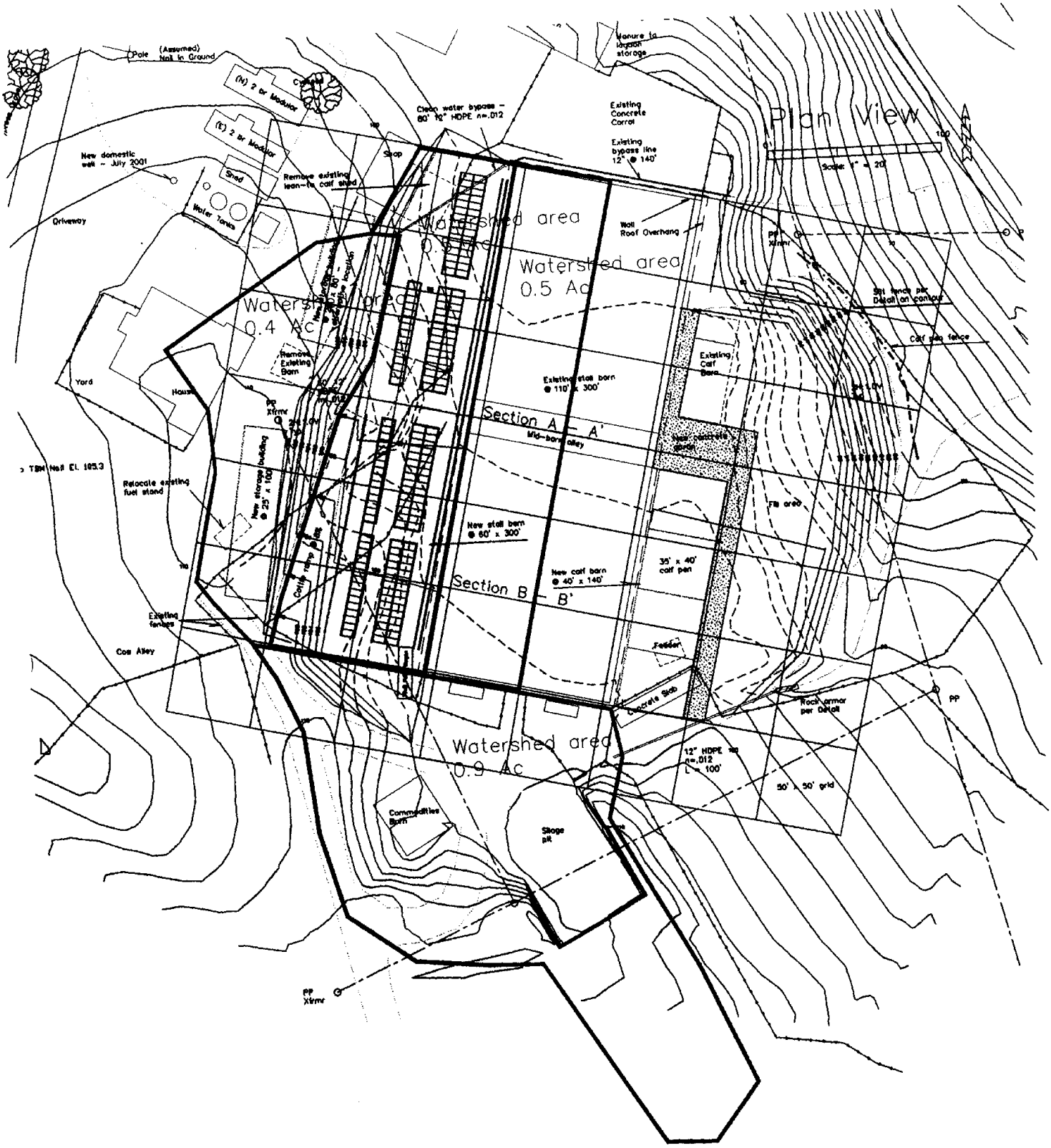
Location Sketch

USGS 7.5–min Quad map: Tomales
Scale: 1" = 1000' 20' Contours

Kehoe Dairy - Watershed Areas

Erickson Engineering Inc.
Valley Ford CA 94972-0446
707/795-2498 Voice/Fax

June 4, 2002
USGS 7.5min Map: Tomales
Scale: 1" = 1000' Contour Interval 20'


Plan View
Scale 1" = 20'
Watershed area
0.5 Ac
Watershed area
0.4 Ac
Watershed area
0.9 Ac
Section A – A'
Mid-barn alley
Section B – B'
Existing stall barn
@ 110' x 300'
New stall barn
@ 60' x 300'
New calf barn
@ 40' x 140'
35' x 40'
calf pen
Existing
Calf
Barn
Existing
Concrete
Corral
Manure to
lagoon
storage
Existing
bypass line
12" @ 140'
Clean water bypass –
60' 12" HDPE n=.012
Wall
Roof Overhang
Remove existing
lean-to calf shed
Remove
Existing
Barn
Shed
Water Tanks
Driveway
Yard
House
New domestic
well – July 2001
(M) 2 or Modular
(E) 2 br Modular
Relocate existing
fuel stand
New storage building
@ 25' x 100'
Cattle ramp
Existing
fences
Cow Alley
Feeder
Concrete Slab
Fill area
Rock armor
per Detail
12" HDPE
n=.012
L= 100'
50' x 50' grid
Commodities
Barn
Silage
pit
Calf pen fence
Silt fence per
Detail on contour
PP
Xfrmr
PP
Xfrmr
PP
Pole (Assumed)
Not in Ground
TBM Nail El. 105.3

Erickson Engineering Inc, Valley Ford CA 94972-0446

Marin County Hydrology
Kehoe Ranch
Barn Pad Grading/Drainage

File: xl2000/projects/kehoe/hydro
Time: 11:18 AM
Date: 05-Jun-02
Updated: 04-Jun-02

Methodology and references from Caltrans, District 4.

Design Rainfall Intensity, Map "I"
1-hour, 100-year isohyets
I-1,100 = 1.65 inches/hour

Design Rainfall Variations, Map V
Site is Zone A1
1.65 i in/hr

Runoff coefficient "c" = 1.0 for direct surface precip, no watershed area.
Runoff coefficient "c" = .45 for rural vegetated areas, slopes < 20%,
Calculate Time of Concentration Tc for each site Tc ={ [1.8*(1.1-c)*I^.5] / [s*(100)]^1/3 } + 5 min.

	c	Watershed Dimension L, ft.	delta H, ft.	Slope s, ft/ft	Tc, min.	Chart K I-1,100 iph
West hill and cut bank	0.45	150	12	0.080	40.4	1.8
Barn Roof (New Section)	1.00	60	6	0.100	7.8	4.8
Barn Roof (Old Section)	1.00	60	6	0.100	7.8	4.8
Silage to east swale	0.45	180	10	0.056	60.8	1.65

Use Chart "K" for Zone A to evalutate Intensity (in/hr) for use at each site.
Find chart curve using I-1,100 = 1.65 iph at Tc = 60 min.
Read I-1,100 for each site at Tc values in table above.

	c	Chart K I-1,100 iph	Topo map Acres	Q = c*i*A Q100 cfs	Q500/Q100 1.22 Q500 cfs	1000/Q100 1.33 Q1000 cfs
West hill and cut bank	0.45	1.8	0.4	0.3	0.4	0.4
Barn Roof (New Section)	1.00	4.8	0.4	2.0	2.4	2.6
Barn Roof (Old Section)	1.00	4.8	0.4	2.0	2.4	2.6
Cumulative Total for freshwater diversion, west side				4.3	5.2	5.7
Silage to east swale	0.45	1.65	0.9	0.7	0.8	0.9

From Chart K for (25 min < Tc <50 min), 10 vs 100 yr intensity ratio = .64-.65
From Frequency Distribution Ratio Chart "R", multipliers for various return periods may be found.
For R (10/100) = .64-.65, 500-yr = 1.22 x 100 yr.
For R (10/100) = .64-.65, 1000-yr = 1.33 x 100 yr.
For R (10/100) = .64-.65, 2000-yr = 1.43 x 100 yr.

Use Mannings Equation to evaluate minimum pipe sizes

Q100 used for design flows - Low Risk location
Agricultural facility

Mannings Equation, Circular section
Provides V, Q based on Diameter for given n, slope

West Side of Barn Q100 = 4.3 cfs
12" culvert System For roof gutters, Bypass Flows

Input Parameters		Output Parameters		
12.0 inch pipe diameter	H2O Depth d:	7.00 inches	0.58	ft at outlet
0.58 d/D ratio ← ok	Sector above H2O:	1.40 ft	2.09	Froude No.
0.012 Manning's n	Circumfrence:	3.14 ft	2.54	ft crit depth
0.030 s, channel slope ft/ft	theta:	2.81		
33.333 1/s, chl slope, ft/100 ft	Water area:	0.48 sq ft	0.79	pipe area
0.6 C, inlet coefficient	Wetted Perim:	1.74 ft		
	Hydraulic Radius:	0.27 ft	Inlet at pipe depth	
Provide rock riprap @ outfall → Short term Flow - ok	Outlet Velocity:	9.04 ft/sec	CA(2gd)^.5	
	Outlet Flow Rate:	4.30 cfs	3.78	cfs inlet
Outfall Parameters	Max Outfall Time:	0.86 sec; (2D/g)^.5		
	Max/Actual Transition Distances:	7.80 ft; V(t)	4.55	ft; V(t)

Mannings Equation, Trapezoidal Sections
Reference Brater and King, Chapter 7

Vee DitchW side of Barn Q100 = .3 cfs
Cow ramp area
Vegetated ok

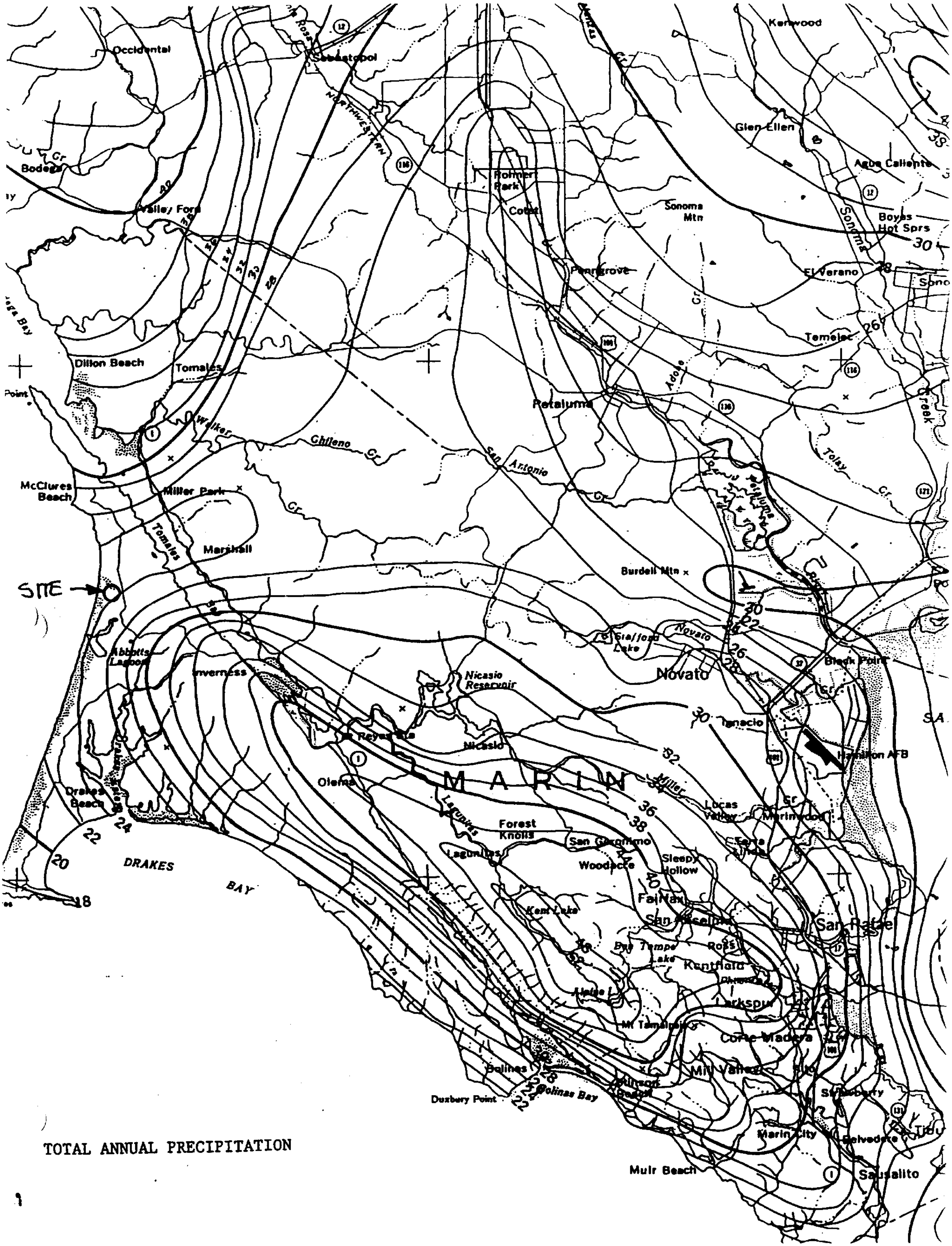
Input Parameters		Output Parameters		
0.15	Normal depth, ft	0.30 cu ft/sec	Flow capacity	
0.035	Manning's n	2.59 Ft/sec	Velocity	non-erosive
0.080	s, channel slope ft/ft (Ramp Slope)	0.12 Sq Ft	Area	ok
12.50	1/s, channel slope, ft/100ft	1.08 Ft	Topwidth	
2.0	Z, side slope, ft/ft	0.10 Ft	Velocity Head	
0.5	b, bottom width, ft	0.25 Ft	Energy Head	
		1.20 V/(gd)^.5	Froude #:	Supercrit

Mannings Equation, Circular section
Provides V, Q based on Diameter for given n, slope

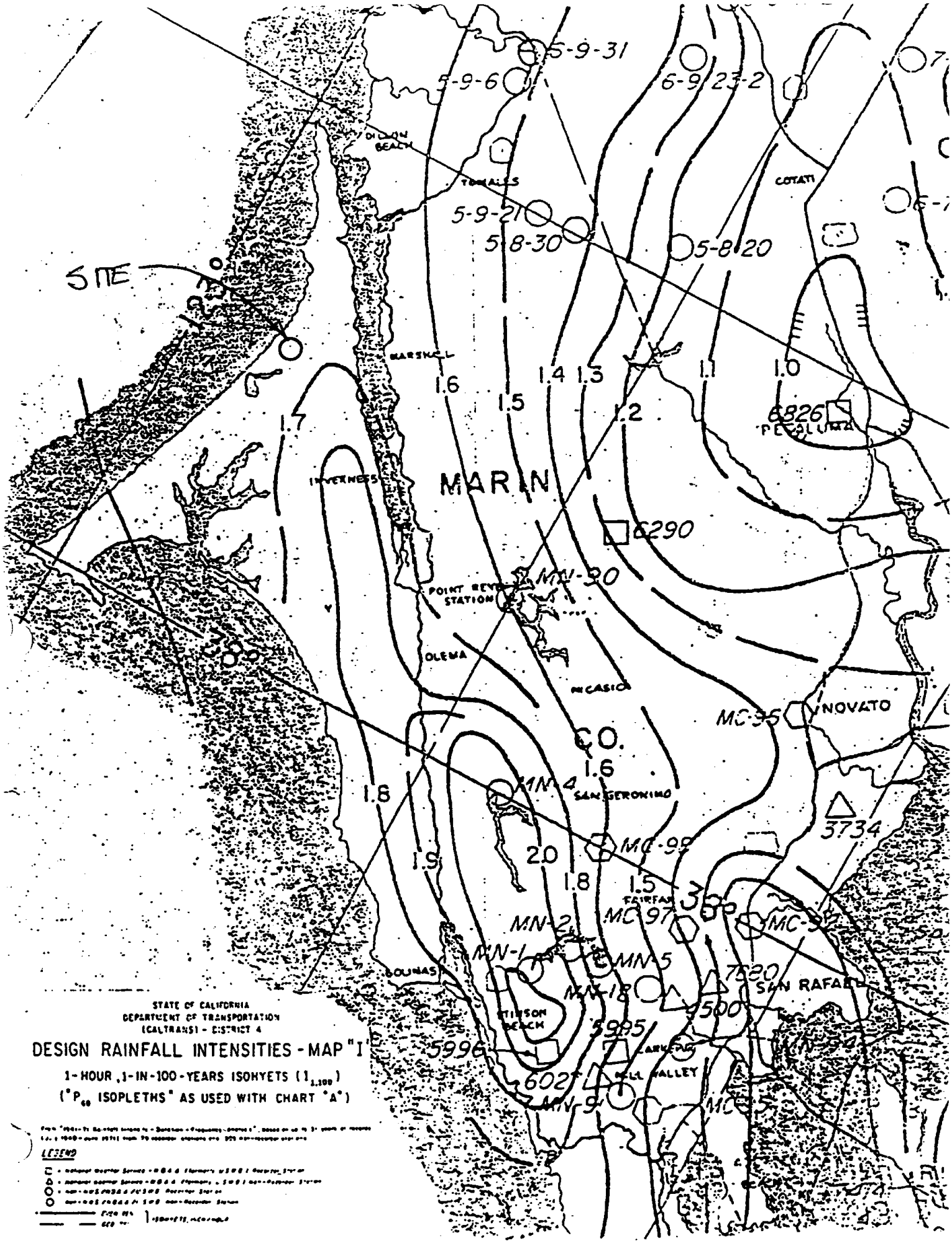
East side culvert Q100 = 0.7 cfs
under/around new calf pens

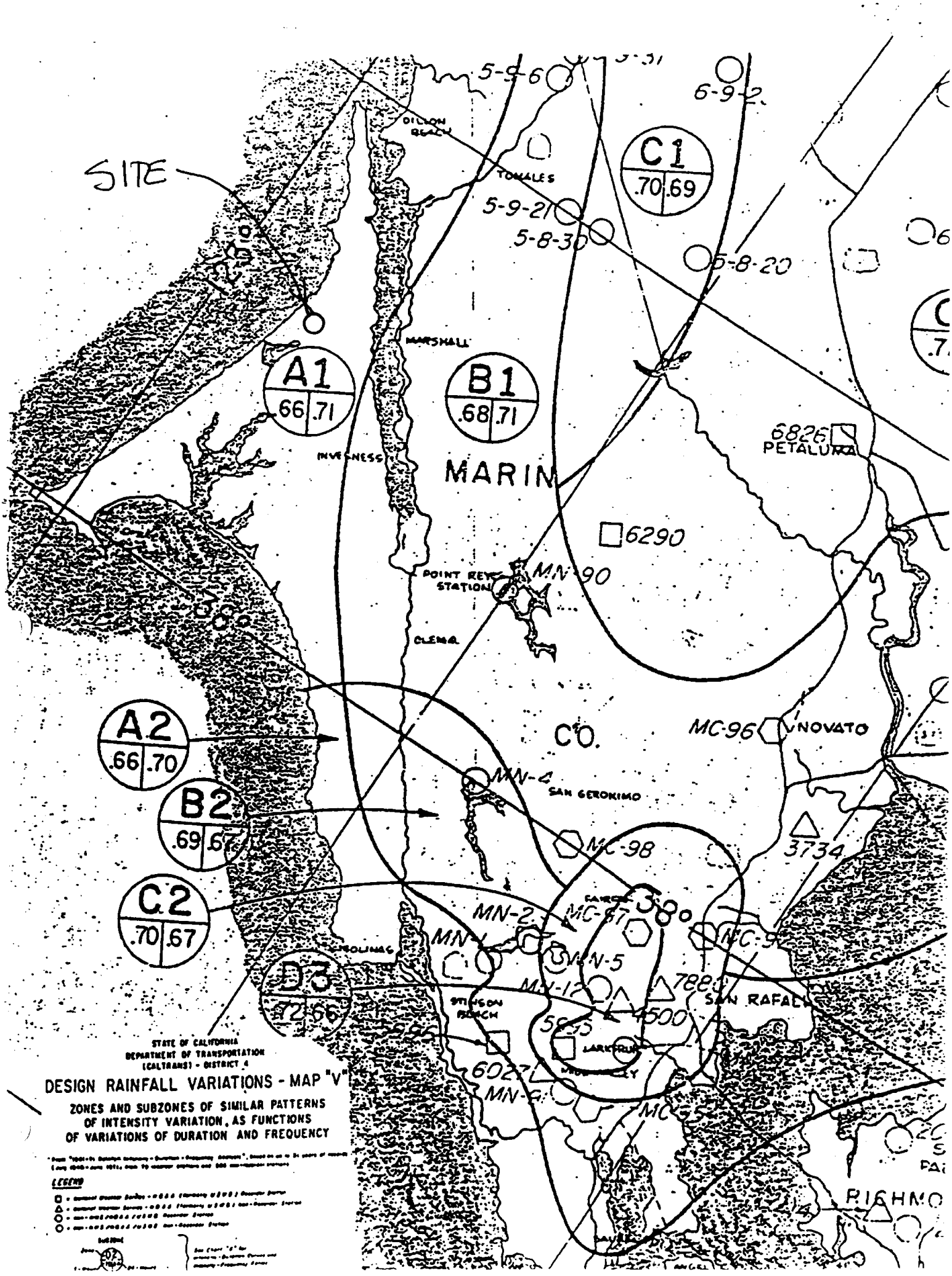
Input Parameters		Output Parameters		
12.0 inch pipe diameter	H2O Depth d:	2.62 inches	0.22	ft at outlet
0.22 d/D ratio ok	Sector above H2O:	2.17 ft	2.08	Froude No.
0.012 Manning's n	Circumfrence:	3.14 ft	0.95	ft crit depth
0.030 s, channel slope ft/ft	theta:	4.34		
33.333 1/s, chl slope, ft/100 ft	Water area:	0.13 sq ft	0.79	pipe area
0.6 C, inlet coefficient	Wetted Perim:	0.97 ft		
	Hydraulic Radius:	0.13 ft	Inlet at pipe depth	
Rock armor @ outfall per detail →	Outlet Velocity:	5.52 ft/sec ok	CA(2gd)^.5	
	Outlet Flow Rate:	0.70 cfs	3.78	cfs inlet
Outfall Parameters	Max Outfall Time:	0.86 sec; (2D/g)^.5		
	Max/Actual Transition Distances:	4.76 ft; V(t)	1.04	ft; V(t)

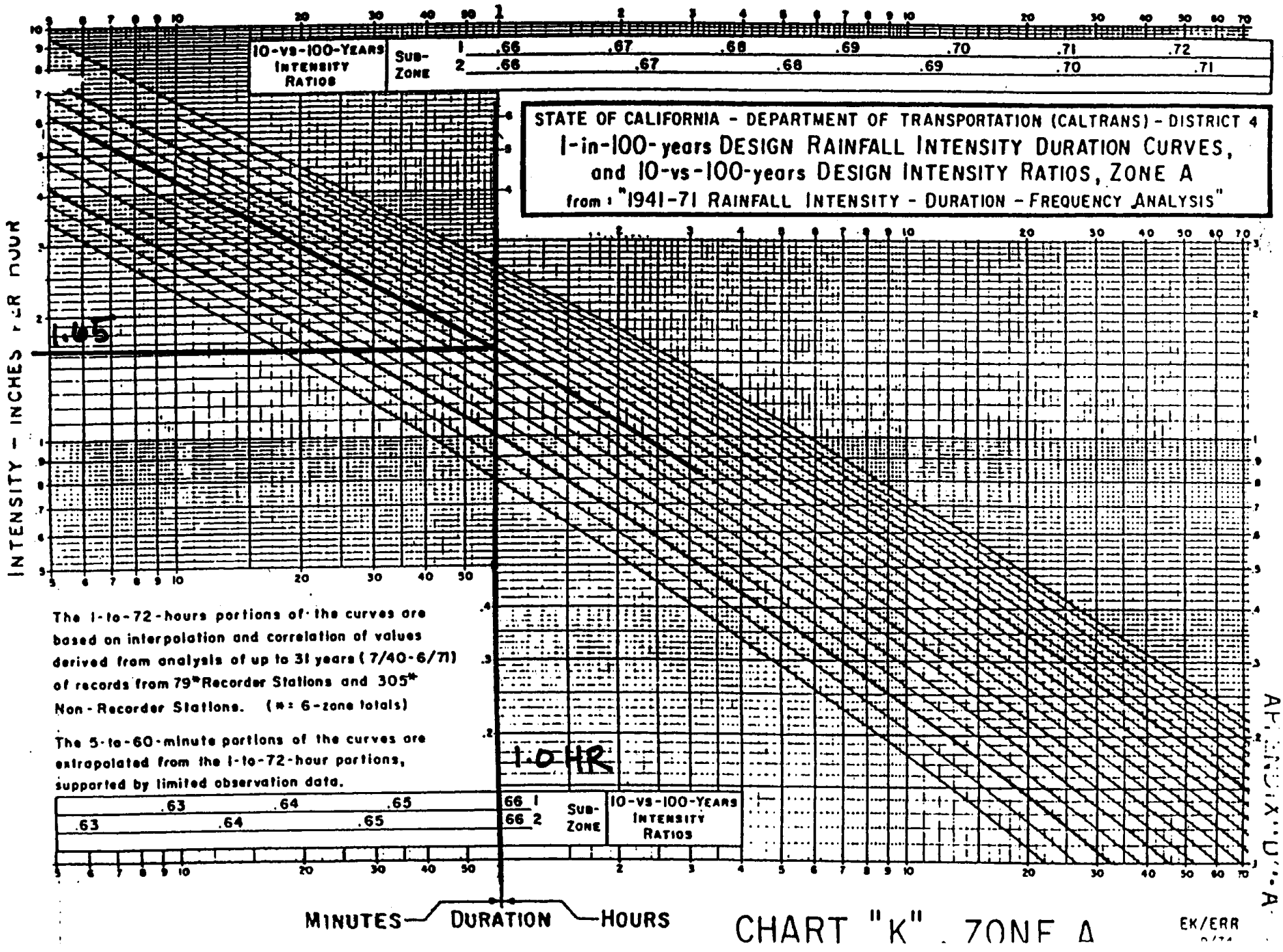
12" Lines used to accomodate potential debris, maintain excess capacity



TOTAL ANNUAL PRECIPITATION


5-9-31
5-9-6
6-9-23-2
DILLON BEACH
TOMALES
COTATI
5-9-21
5-8-30
5-8-20
SITE
MARSHALL
1.6
1.5
1.4
1.3
1.2
1.1
1.0
1.7
6826
PETALUMA
INVERNESS
MARIN
6290
MN-30
POINT REYES STATION
OLEMA
NICASIO
MC-35
NOVATO
CO.
1.6
1.8
MN-4
SAN GERONIMO
3734
MC-99
2.0
1.9
1.8
1.5
FAIRFAX
MC-97
MC-3
MN-2
MN-1
MN-5
MN-18
7820
SAN RAFAEL
BOLINAS
STINSON BEACH
5995
5996
9500
602
MILL VALLEY
MN-9
MC-5
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
(CALTRANS) - DISTRICT 4
DESIGN RAINFALL INTENSITIES - MAP "I"
1-HOUR, 1-IN-100-YEARS ISOHYETS ($I_{1,100}$)
("P_{60} ISOPLETHS" AS USED WITH CHART "A")
LEGEND

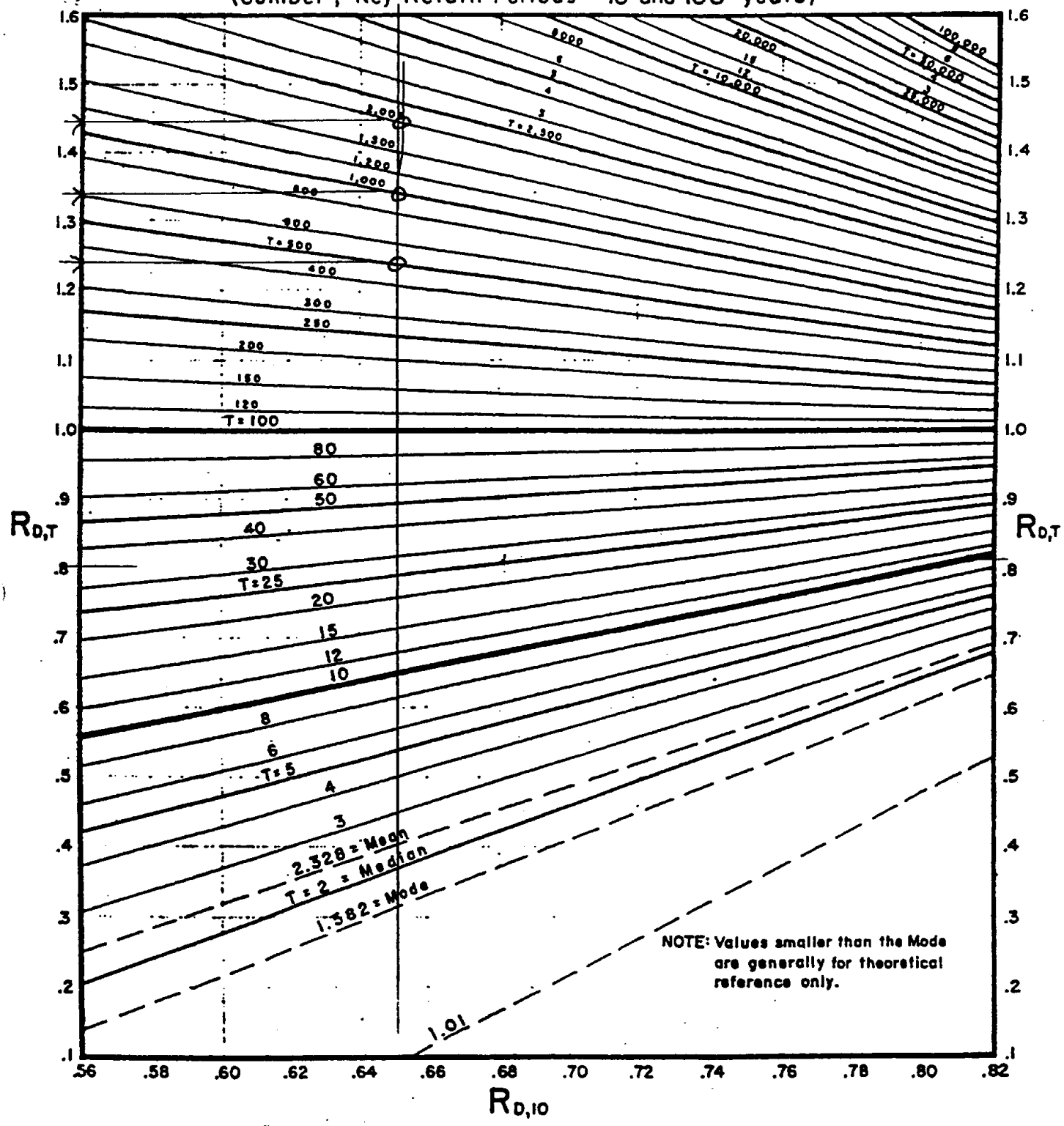

SITE
A1
.66 .71
B1
.68 .71
C1
.70 .69
A2
.66 .70
B2
.69 .67
C2
.70 .67
D3
.72 .66
MARIN
CO.
MARSHALL
INVERNESS
POINT REYES STATION
OLEMA
TOMALES
DILLON BEACH
PETALUMA
6826
6290
MN-90
MC-96
NOVATO
MN-4
SAN GEROKIMO
MC-98
3734
MN-2
MC-87
MN-5
MN-12
7880
SAN RAFAEL
4500
5855
6027
STINSON BEACH
LARKSPUR
RICHMO
5-9-6
6-9-2
5-9-21
5-8-30
5-8-20
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
(CALTRANS) - DISTRICT 4
DESIGN RAINFALL VARIATIONS - MAP "V"
ZONES AND SUBZONES OF SIMILAR PATTERNS
OF INTENSITY VARIATION, AS FUNCTIONS
OF VARIATIONS OF DURATION AND FREQUENCY
LEGEND


10-VS-100-YEARS INTENSITY RATIOS
SUB-ZONE
1 .66 .67 .68 .69 .70 .71 .72
2 .66 .67 .68 .69 .70 .71
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION (CALTRANS) - DISTRICT 4
1-in-100-years DESIGN RAINFALL INTENSITY DURATION CURVES,
and 10-vs-100-years DESIGN INTENSITY RATIOS, ZONE A
from: "1941-71 RAINFALL INTENSITY - DURATION - FREQUENCY ANALYSIS"
INTENSITY - INCHES PER HOUR
1.65
1.0 HR
The 1-to-72-hours portions of the curves are based on interpolation and correlation of values derived from analysis of up to 31 years (7/40-6/71) of records from 79* Recorder Stations and 305* Non-Recorder Stations. (*= 6-zone totals)
The 5-to-60-minute portions of the curves are extrapolated from the 1-to-72-hour portions, supported by limited observation data.
.63 .64 .65
.63 .64 .65
66 1
66 2
SUB-ZONE
10-VS-100-YEARS INTENSITY RATIOS
MINUTES
DURATION
HOURS
CHART "K" ZONE A
EK/ERR
APPENDIX "A"

STATE OF CALIFORNIA – DEPARTMENT OF TRANSPORTATION (CALTRANS) – DISTRICT 4

FREQUENCY DISTRIBUTION RATIOS CHART "R"

(Gumbel ; Key Return Periods = 10 and 100 years)



EQUATIONS SEE "1941-71 RAINFALL INTENSITY-DURATION-FREQUENCY ANALYSIS"

(29) $R_{D,T} = I_{D,T} / I_{D,100}$, where

(31) $I_{D,T} = I_{D,100}\left\{1 + \left[\left(\frac{1-R_{D,10}}{y_{100}-y_{10}}\right)(y_T - y_{100})\right]\right\}$ and

( ) $y_T = -\ln\left[-\ln(1-1/T)\right]$

T = Return Period, Years
R = Ratio
I_D = Intensity (For a given duration D), Inches/Hr.

Other parameters, such as discharge rate (Q) may be substituted for T.